CSC 3501 Computer Organization and Design

Homework #1 Solution

Chapter 1 Exercises

10.

Care must be taken when programming to make sure the code doesn't modify itself in some way. For example, if a memory location holds an instruction (which is represented by a binary number), and a value is added to that instruction, the result could be a valid instruction (since addition of binary gives a binary) that is later executed, resulting in an error that is very difficult to track down. The modification of an instruction could also cause a program to crash.

13.

a. After 4.5 years, if Moore's Law holds, processors would be 8 times faster. So your technology, if it increased the speed of current processors by 6 times, would be slower than the new ones. Its better to invest in some different venture.

b. With the current technology and new algorithm, finding a solution requires 50,000 hours (2083.3 days, not quite 6 years). With the new technology and the original algorithm, the performance is sped up by 4 times. We wait three years to start (26280 hours) + 25000 to actually run the program results in 51280 hours. The solution is found more quickly using the new algorithm. However, considering we had to wait three years to start, these numbers are fairly close.

14.

There are technical limitations, including heat dissipation and power leakage, not to mention the physical limitations of space and the fact that transistors can only get so small (we can't go smaller than the size of an atom).

Chapter 2. Review of Essential Terms and Concepts

15.

Carry is generally used for unsigned arithmetic and overflow is used for signed arithmetic. This unsigned operations results in carry, but no overflow (the sign of the result is correct). However, overflow occurs when the resulting number is too large to store in memory location.

18.

Normalization is the process in which we represent floating point numbers uniquely, hence, there is exactly one way to write a real number in such a form. In normalized representation of floating point numbers, the leftmost bit of the significand must always be 1. It is necessary as it offers following advantages:

- It's easy to compare two normalized numbers, you separately test the sign, exponent and mantissa.
- In a normalized form, a fixed size mantissa will use all the 'digit cells' to store significant digits.

Chapter 2. Exercises

4.

a. 11001.11011
b. 111001.100011
c. 1010000.11101
d. 1010100.110111

5.

c. Signed magnitude: 01110111
One's complement: 01110111
Two's complement: 01110111

d. Signed magnitude: 11101011
One's complement: 10010100
Two's complement: 10010101

9.

b. Largest Positive: 0111112 (31) Smallest Negative: 1000002 (−32)

11.

c) 100111000

38.

Bit 1 checks 1,3,5,7,9 and 11, but this is an odd number of 1's => error
Bit 2 checks 2,3,6,7,10, and 11, which is an odd number of 1's => error
Bit 4 checks 4,5,6, and 7, which is an even number of 1's => ok
Bit 8 checks 8,9,10, and 11, which is an odd number of 1's => error
Since errors occur in bit positions 1, 2, and 8, the error is in bit number 1+2+8=11